

CLAIMS

1. A mobile telecommunication antenna embedded in a case in use comprising:

5 a radiation-conductive element arranged substantially in vertical to a longitudinal direction of the case and located at an upper region in the case; and

a power supply terminal for electrically coupling the radiation-conductive element to a high-frequency circuit embedded in the case, wherein an electrical length of the radiation-conductive element is
10 substantially $n/2$ wavelength (where n is an odd number).

2. The mobile telecommunication antenna according to claim 1, wherein the electrical length of the radiation conductive element is substantially $n/4$ wavelength (where n is an odd number).

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3. A mobile telecommunication antenna embedded in a case in use comprising:

first and second radiation-conductive elements both arranged substantially in vertical to a longitudinal direction of the case and located at
20 an upper region in the case; and

a power supply terminal electrically coupling the first radiation-conductive element to a high-frequency circuit embedded in the case, wherein the first and second radiation conductive elements are electrically insulated from each other for being operable in a plurality of different
25 frequency bands.

4. The mobile telecommunication antenna according to claim 3 further

comprising a third radiation-conductive element arranged at an upper region in the case and electrically insulated from both the first and second radiation conductive elements.

5 5. The mobile telecommunication antenna according to claim 3, wherein the first and second radiation-conductive elements are formed by a helical element and a zigzag meander element, respectively, or the first and second radiation-conductive elements are formed by a zigzag meander element and a helical element, respectively.

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6. The mobile telecommunication antenna according to claim 3, wherein both the first and second radiation-conductive elements are formed by helical elements or zigzag meander elements.

15 7. The mobile telecommunication antenna according to claim 3 further comprising a resin molded body accommodating the first and second radiation-conductive elements therein integrally by resin molding.

20 8. The mobile telecommunication antenna according to claim 7, wherein the power supply terminal is formed on the resin molded body, and wherein the mobile telecommunication antenna is mounted by the power supply terminal to a printed circuit board on which the high-frequency circuit is mounted.

25 9. The mobile telecommunication antenna according to claim 7, wherein the first and second radiation-conductive elements are formed by a pressing process.

10. The mobile telecommunication antenna according to claim 3 further comprising a dielectric substrate including the first and second radiation-conductive elements, wherein the first and second radiation-conductive
5 elements are formed by one of a conductive pattern and a combination of a conductive pattern and a through-hole at least one of on a surface and an inside of the dielectric substrate.

11. The mobile telecommunication antenna according to claim 10,
10 wherein the power supply terminal is formed on a surface of the dielectric substrate, and wherein the mobile telecommunication antenna is mounted by the power supply terminal on a surface of a printed circuit board where the high-frequency circuit is mounted thereon.

12. The mobile telecommunication antenna according to claim 5 further comprising a dielectric substrate in which a helical axis of the helical
15 element and a zigzag direction of the meander element are arranged substantially in parallel with the longitudinal direction of the dielectric substrate.

20 13. The mobile telecommunication antenna according to claim 5, wherein a helical axis of the helical element and a zigzag direction of the meander element are arranged substantially in orthogonal to a longitudinal direction of the case.

25 14. The mobile telecommunication antenna according to claim 5 further comprising a dielectric substrate in which a helical axis of the helical

element is arranged substantially in parallel with a longitudinal direction of the dielectric substrate, and a zigzag direction of the meander element is arranged substantially in orthogonal to the longitudinal direction of the dielectric substrate.

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15. The mobile telecommunication antenna according to claim 5 further comprising a dielectric substrate in which a helical axis of the helical element is arranged substantially in orthogonal to a longitudinal direction of the dielectric substrate, and a zigzag direction of the meander element is
10 arranged substantially in parallel with the longitudinal direction of the dielectric substrate.

16. The mobile telecommunication antenna according to claim 5, wherein the meander element is located at an outside of the helical element.

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17. The mobile telecommunication antenna according to claim 6 further comprising a dielectric substrate in which a helical axis of the two helical elements or a zigzag direction of the two meander elements are arranged substantially in parallel with a longitudinal direction of the dielectric
20 substrate.

18. The mobile telecommunication antenna according to claim 6 further comprising a dielectric substrate in which helical axes of the two helical elements or zigzag directions of the two meander elements are arranged
25 substantially in orthogonal to a longitudinal direction of the dielectric substrate.

19. The mobile telecommunication antenna according to claim 6,
wherein a helical axis of one of the two helical elements is arranged different
from a helical axis of other of the one of the two helical elements, or a zigzag
direction of one of the two meander elements is arranged different from a
5 zigzag direction of the other of the one of the two meander elements.

20. The mobile telecommunication antenna according to claim 6,
wherein one of the two helical elements is located inside of other of the one of
the two helical elements.

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21. The mobile telecommunication antenna according to claim 6,
wherein the two meander elements are arranged with or reversed from each
other in zigzag patterns.

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22. The mobile telecommunication antenna according to claim 17,
wherein the helical axes of the two helical elements or the zigzag directions
of the two meander elements are aligned in parallel or coaxial with each
other.

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23. The mobile telecommunication antenna according to claim 18,
wherein the helical axes of the two helical elements or the zigzag directions
of the two meander elements are aligned in parallel or coaxial with each
other.

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24. A mobile telecommunication antenna embedded in a case in use
comprising:

a first radiation-conductive element arranged substantially in

parallel with a grounding substrate and located at an upper region in the case;

5 a second radiation-conductive element arranged substantially in vertical to the grounding substrate and located at an upper region in the case; and

a power supply terminal for electrically coupling at least one of the radiation-conductive elements to a high-frequency circuit embedded in the case,

10 wherein the first and second radiation-conductive elements are electrically coupled to each other, and at least one of the radiation-conductive elements is electrically coupled to the grounding substrate for being operable in a plurality of different frequency bands.

25 25. The mobile telecommunication antenna according to claim 24 further comprising a body, wherein the body is made of dielectric material and accommodating the first and second radiation-conductive elements at least one of on a surface of the body and in the body, or wherein the body is made of magnetic material and accommodating the first and second radiation-conductive elements on a surface of the body.

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26. A mobile telecommunication apparatus comprising:

an operation unit;

a display;

a speaker;

25 a microphone;

a case;

a high-frequency circuit embedded in the case

an antenna disposed substantially in vertical to a longitudinal direction of the case, comprising:

a radiation-conductive element disposed at an upper region in the case; and

5 a power supply terminal electrically connecting the radiation conductive element to the high-frequency circuit,

wherein an electrical length of the radiation-conductive element is substantially $n/2$ wavelength or $n/4$ wavelength (where n is an odd number).

10 27. The mobile telecommunication apparatus according to claim 26 further comprising a printed circuit board where the high-frequency circuit is mounted thereon, and a notch is formed in an upper end thereof for accommodating the antenna.

15 28. The mobile telecommunication apparatus according to claim 26 further comprising a printed circuit board where the high-frequency circuit is mounted thereon, wherein the antenna is mounted at an upper end of the printed circuit board and projecting from both sides of the printed circuit board.

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29. A mobile telecommunication apparatus operable in a plurality of different frequency bands comprising:

an operating unit;

a display;

25 a speaker;

a microphone;

a case;

a high-frequency circuit embedded in the case; and

an antenna embedded in the case and disposed substantially in vertical to a longitudinal direction of the case, comprising:

first and second radiation-conductive elements disposed at
5 an upper region in the case; and

a power supply terminal electrically coupling the first radiation conductive element to the high-frequency circuit, wherein the first and second radiation-conductive elements are electrically insulated to each other.

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30. The mobile telecommunication apparatus according to claim 29, wherein the first and second radiation-conductive elements are formed by a helical element and a zigzag meander element, respectively, or the first and second radiation-conductive elements are formed by a zigzag meander
15 element and a helical element, respectively.

31. The mobile telecommunication apparatus according to claim 29, wherein both the first and second radiation-conductive elements are formed by helical elements or zigzag meander elements.

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32. The mobile telecommunication apparatus according to claim 29, wherein the antenna further comprises a resin molded body assembling the first and second radiation-conductive elements therein integrally by resin molding.

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33. The mobile telecommunication apparatus according to claim 32 further comprising a printed circuit board where the high-frequency circuit

is mounted, wherein the power supply terminal is formed on the resin molded body, and wherein the antenna is mounted by the power supply terminal to the printed circuit board.

5 34. The mobile telecommunication apparatus according to claim 32, wherein the first and second radiation-conductive elements are formed by a pressing process.

10 35. The mobile telecommunication apparatus according to claim 29, wherein the antenna further comprises a dielectric substrate where the first and second radiation-conductive elements are formed by one of a conductive pattern and a combination of a conductive pattern and a through-hole at least one of on a surface and an inside of the dielectric substrate.

15 36. The mobile telecommunication apparatus according to claim 35 further comprising a printed circuit board where the high-frequency circuit is mounted thereon, wherein the power supply terminal is formed on a surface of the dielectric substrate, and wherein the antenna is mounted by the power supply terminal on the printed circuit board.

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 37. The mobile telecommunication apparatus according to claim 29 further comprising a printed circuit board where the high-frequency circuit is mounted thereon, and a notch is formed in an upper end thereof for accommodating the antenna.

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 38. The mobile telecommunication apparatus according to claim 29 further comprising a printed circuit board where the high-frequency circuit

in mounted thereon, wherein the antenna is mounted at an upper end of the printed circuit board and projecting from both sides of the printed circuit board.

5 39. A mobile telecommunication apparatus operable in a plurality of different frequency bands comprising

an operating unit;

a display;

a speaker;

10 a microphone;

a case;

a high-frequency circuit embedded in the case;

a grounding substrate; and

an antenna embedded in the case, comprising:

15 a first radiation-conductive element arranged substantially in parallel with the grounding substrate and disposed at an upper region in the case;

 a second radiation-conductive element arranged substantially in vertical to the grounding substrate and disposed at the
20 upper region in the case; and

 a power supply terminal electrically coupling at least one of the first and second radiation-conductive elements to the high-frequency circuit,

 wherein the first and second radiation-conductive elements are electrically
25 coupled to each other, and at least one of the first and second radiation-conductive elements is electrically coupled to the grounding substrate.

40. The mobile telecommunication apparatus according to claim 37,
wherein the antenna further comprises a body, wherein the body is made of
dielectric material and accommodating the first and second radiation-
conductive elements at least on a surface of the body and in the body, or
5 wherein the body is made of magnetic material accommodating the first and
second radiation-conductive elements on a surface of the body.